THE RELATION BETWEEN SELF-REGULATION SKILLS AND EMERGENT AND EARLY WRITING IN PRESCHOOL AND KINDERGARTEN CHILDREN

by

Emily Boss

B.A. Communication Science and Disorders, University of Pittsburgh, 2012

Submitted to the Graduate Faculty of

University of Pittsburgh in partial fulfillment

of the requirements for the degree of

M.S. in Speech-Language Pathology

University of Pittsburgh

2014

UNIVERSITY OF PITTSBURGH

SCHOOL OF HEALTH AND REHABILITATION SCIENCES

This thesis was presented

by

Emily Boss

It was defended on

April 1, 2014

and approved by

Connie Tompkins, PhD, Professor, Department of Communication Science and Disorders, University of Pittsburgh

Deborah Moncrieff, PhD, Assistant Professor, Department of Communication Science and Disorders, University of Pittsburgh

Cynthia Puranik, PhD, Assistant Professor, Department of Communication Science and Disorders, University of Pittsburgh

Shannon Wanless, PhD, Assistant Professor, Department of Psychology in Education, University of Pittsburgh

Thesis Director: Cynthia Puranik, PhD, Assistant Professor, Department of Communication Science and Disorders, University of Pittsburgh

THE RELATION BETWEEN SELF-REGULATION SKILLS AND EMERGENT AND EARLY WRITING IN PRESCHOOL AND KINDERGARTEN CHILDREN

Emily Boss, MS

University of Pittsburgh, 2014

Past research has established that self-regulation may play an important role in the early academic skills such as math and literacy, but has focused less on relations with other early skill domains such as writing (Ponitz, McClelland, Matthews & Morrison, 2009; McClelland, Cameron, Connor, Farris, Jewkes, & Morrison, 2007; Howse, Calkins, Anastopoulos, Keane, & Shelton, 2003). In one previous study on older children, however, there was evidence to suggest that self-regulation significantly related to more advanced writing skills (Graham, Harris & Mason, 2005). The purpose of the present study was to extend that line of study to younger children, by assessing the relation of self-regulation to early writing.

Preschool (n=161) and kindergarten (n=139) children, ages 4-6 years, were participants in this study. The preschool assessment battery included measures of early/emergent writing (name writing, letter writing, and spelling) and a direct measure of self-regulation (Head-Toes-Knees-Shoulders task; HTKS). Kindergarteners received the preschool battery as well as measures of letter writing fluency, a standardized measure of spelling, and a standardized measure of writing to capture knowledge of writing and composition skill. Data were analyzed using multi-level modeling.

The results of this study indicated that self-regulation was significantly related to writing skills for both grade levels, but not as expected. Self-regulation was significantly and positively related to letter writing and spelling only for preschool children. Contrary to expectations, self-

regulation did not significantly contribute to predicting performance on the advanced measures of letter writing fluency and spelling for the kindergarten children. It did, however, relate to knowledge of writing and composition tasks in kindergarten. This study expands current literature on the role of self-regulation in children's writing by demonstrating the relation of self-regulation to emergent writing. Discussion highlights the potential for early assessments and classroom structuring to support children with low self-regulation. Future research should focus on a wider assessment battery to account for task-specific findings and evaluate whether preschool self-regulation scores relate to writing scores in later years.

TABLE OF CONTENTS

LIST OF TABLES

PREFACE

I would like to thank my committee members, Dr. Shannon Wanless, Dr. Deborah Moncrieff and Dr. Connie Tompkins for their contribution of time and infinite wisdom, and for their willingness to share their expertise throughout this journey. An extra special thank you is extended to Dr. Wanless. She rendered assistance at many levels. She supplied the required software for me to run the statistics and analyze the project results. Her expert knowledge and experience with statistics was an enormous added benefit. I am also very appreciative for the suggestions and encouragement that all of my committee members provided as final editors. Last, but not least, I am eternally grateful for my committee chair, Dr. Cynthia Puranik, my source of strength for many years. She has provided moral support, endless guidance, countless hours and expert input for this study. Her expertise and feedback in the form of discussions and edits have been extremely helpful in this process.

Support for this research project was provided by a grant the Institute of Education Science, US Department of Education (R305A080488; PI- Cynthia Puranik).

1.0 INTRODUCTION

As the foundation for critical and more advanced writing skills, early and emergent writing has been a recent focus of research. A substantial number of studies have investigated various components that contribute to the complex process of writing (Hayes, 1996; Puranik & Lonigan, 2012; Dyson, 1983; Puranik & Al Otaiba, 2012; Kim, AlOtaiba, Puranik, Folsom, Greulich, & Wagner, 2011; Bourdin & Fayol, 1994; Bourdin, Fayol, & Darciaux, 1996; Graham & Harris, 2000; Olive & Kellogg, 2002). However, the contributing effects of behavioral components such as self-regulation have received little attention, despite the established relation of self-regulation and writing skills in older children (Graham & Harris, 2000; Graham, 1997; Graham, Harris, & Mason, 2005) and preliminary evidence suggesting that self-regulation may play a role in emergent writing starting as early as preschool (Gerde, Skibbe, Bowles, & Martoccio, 2012). A significant amount of literature has focused on the preschool and kindergarten population and has established a relation between self-regulation and other academic skills, such as math and reading (Ponitz, McClelland, Matthews, & Morrison, 2009; McClelland, Cameron, Connor, Farris, Jewkes, & Morrison, 2007; Howse, Calkins, Anastopoulos, Keane, & Shelton, 2003). The goal of current study is to extend current understanding regarding the role of self-regulation on children's writing, examining its potential impact in preschool and kindergarten by assessing its relation to various emergent/early writing skills.

1.1 EMERGENT WRITING

Writing is an essential skill to function in today's world. It is an expression of ideas that makes conceptualized thoughts more tangible to others. Accordingly, good writing skills are fundamental to effective communication. As such, they can directly affect success in academics and careers. Most contexts of life require some proficiency in writing. As a matter of fact, more than 90 percent of mid-career professionals identified effective writing as an important and necessary skill in their daily work (National Commission on Writing, 2003). In spite of writing's firmly established relevance, an alarming 74% of 8th graders and 73% of 12th graders failed to perform at or above the proficient level according to National Assessment of Educational Progress (NAEP) writing assessment in 2011 (National Assessment of Educational Progress, 2011). This widespread lack of writing proficiency provides justification to focus attention on developing early writing skills, and to examine factors that contribute to the development of writing. Building a stronger writing foundation early may increase the likelihood of developing more effective writing skills later.

Similar to the development of reading skills, writing skills develop early, even before formal instruction begins. Beginning in preschool, young children draw or scribble to communicate meaning through print. Children's early scribbles show evidence of both universal (e.g., linearity and segmentation) and language specific writing features (e.g., left-to-right directionality and letter shapes) (Tolchinsky, 2003; Puranik & Lonigan, 2011). Children soon learn to write their first names. In fact, first names are among the first words children learn to write conventionally (Bloodgood, 1999; Levin & Bus, 2003; Levin & Aram, 2004). In conjunction with name writing, they begin to learn to write letters of the alphabet. Many preschool children also demonstrate the ability to spell simple consonant-vowel-consonant

(CVC) words (Puranik & Lonigan, 2011). Thus, by the time a child enters formal school settings, many foundational writing skills have begun to develop.

Once children reach kindergarten, name writing becomes an automated task with the majority writing their first names conventionally (Bloodgood, 1999). In kindergarten, children, on average, can write 13 letters of the alphabet when assessed on both upper and lowercase letters (Ritchey, 2008). They can also spell simple CVC words using initial and final consonants, and can frequently mark a vowel (Puranik & Al Otaiba, 2012). Improvements in letter writing skills result in improvements in letter writing fluency and spelling (Kim, Al Otaiba, Puranik, Folsom, Greulich, & Wagner, 2011). Both distinct skills, referred to as transcription skills, are significant contributors to the quantity and quality of a child's written expression (Puranik & Al Otaiba, 2012; Kim et al., 2011).

Writing is a complex task. To produce a written product, a child must first generate an idea. Then they must draw upon semantics to convert the idea into language. Finally, they translate the idea into written language, which at its most rudimentary level draws on children's letter writing skills and knowledge of letter-sound correspondence. Past research has indicated that cognition (Hayes, 1996; Puranik & Lonigan, 2012), oral language (Dyson, 1983; Puranik & Al Otaiba, 2012; Kim et al., 2011), and transcription skills (Bourdin & Fayol, 1994; Bourdin, Fayol, & Darciaux, 1996; Graham & Harris, 2000; Olive & Kellogg, 2002) contribute to this complex process. Beyond these, behavioral components are also crucial considerations that can impact a child's writing. Within the areas of behavior, self-regulation is a key contributor to the success of skilled writers (Graham & Harris, 2000). As illustrated by the "Simple View of Writing" (Berninger & Amtmann, 2003), self-regulation is one component which supports the writing process. According to the model, the writing process is constrained by memory and

supported by transcription and self-regulation. As children mature in the writing process, self-regulation skills become important for planning, reviewing, and revising. Preliminary evidence by Gerde et al. (2012) suggests that self-regulation may play an equally important role in early writing as it does for skilled writing. The goal of the current study is to further examine the relation between self-regulation and emergent writing.

1.2 SELF-REGULATION

In a very broad sense, self-regulation refers to the integration of emotion and cognition to regulate one's behavior. Self-regulation refers to a person's ability to focus attention, manage thoughts and emotions, and inhibit some behaviors in favor of other less dominant behaviors (Rimm-Kaufman & Wanless, 2012). Although there are diverse perspectives and hence intense debate in the literature regarding the definition of self-regulation and the skills it encompasses, it is generally assessed by measures that require the integration of inhibitory control, attentional flexibility, and working memory (McClelland & Cameron, 2012). Because self-regulation is a multi-dimensional construct that requires controlling and directing one's actions, emotions, attention, and thinking, it takes years to develop.

Self-regulation begins to develop in childhood through external controls that parents provide to infants. For example, parents who use rocking to soothe a crying child or feeding to satisfy a hungry child are providing external controls and aiding the process of self-regulation. With time, this external control slowly begins to internalize. For example, impulse control develops between 12-18 months and is evidenced through a child's ability to comply with the parental demands of "Don't touch" and "No" placed on the child's environment. At 24 months of

age, self-control—a rudimentary form of the more highly developed self-regulation—becomes apparent. During this phase of development, a child is able to control behaviors in accordance with social expectations. An internal monitor, which helps regulate the child's behavior, also develops during this phase. Although the child is still capable of delaying intended actions upon request, the child no longer relies solely on external monitors such as parents (Kopp, 1982). With the foundation in place, self-regulation emerges in its most basic form around three years of age and it continues to develop through the preschool years.

Although self-regulation takes many years to develop fully, it shows rapid growth potential in early childhood (McClelland & Cameron, 2012). In fact, certain early features, which lay the foundation for self-regulation, develop before the preschool years (Kopp, 1982; Rimm-Kaufman & Wanless, 2012). Children use this foundation of control to adapt to and meet daily situational demands (McClelland & Cameron, 2012) especially when transitioning from the home to day care centers, preschools, and kindergarten.

1.2.1 Self-regulation and Academics

A substantial body of research indicates that self-regulation may be important for students to make a successful transition and learn in a classroom setting (Blair, 2002; Blair & Diamond, 2008). As children transition from the home environment to an academic setting, such as preschool, there is a shift in the demand for self-regulation skills to support classroom learning. These skills help the child meet the daily demands of the immediate classroom environment and can easily be observed and measured through a variety of classroom rules and activities. These measures include the child's ability to focus attention on a given task, or the ability to follow instructions to complete a task or assignment, or raise a hand in response to questions.

Evidence indicates that key components of self-regulation predict academic achievement from preschool into adulthood (e.g., Blair & Razza, 2007; McClelland, Cameron, Connor, et al., 2007; McClelland, Piccinin, & Stallings, 2010). Further, research indicates these skills play a role in early academic success across cultures (Lan, Legare, Ponitz, Li, & Morrison, 2011; Wanless, McClelland, Acock, Chen, & Chen, 2011; Von Suchodoletz et al., 2013). In past research, the primary focus for measures of early academic success has been math, vocabulary, and emergent literacy (Ponitz, McClelland, Matthews, & Morrison, 2009; McClelland et al., 2007; Howse, Calkins, Anastopoulos, Keane, & Shelton, 2003; McClelland, Acock, & Morrison, 2006). During the pre-kindergarten years higher self-regulation scores have been found to correspond with better math, vocabulary, and literacy scores, as well as listening comprehension (Ponitz et al., 2009; McClelland et al., 2007; Howse et al., 2003). Kindergarten children with low self-regulation skills, however, fall increasingly behind more self-regulated peers in math and reading through second grade (McClelland et al., 2006). In fact, the gap in achievement between these groups remains consistent through sixth grade (McClelland et al., 2006). Thus, self-regulation may be imperative to academic success (Ponitz et al., 2009; McClelland et al., 2007; Howse et al., 2003). The relation of self-regulation to academic success highlights the potential importance of focusing on developing self-regulation skills during preschool and kindergarten years as one possible way to help narrow the gap in achievement.

Although the above evidence suggests that self-regulation may be important for academic skills, there is also evidence to indicate that self-regulation may have a differential relation to different academic skills and that this relation may be task-dependent. Specifically, Ponitz et al. (2009) reported that self-regulation was a predictor of growth in math scores for kindergarten children, but not a predictor of growth in literacy or vocabulary scores. Blair and Razza (2007)

reported similar results in a study based on a low-income population. Such results suggest that self-regulation may be a domain specific skill—correlated with learning in some academic areas more than others.

1.2.2 Self-regulation and Math

Although the impact of self-regulation on some disciplines has been contested, self-regulation skills have consistently and positively correlated to math abilities across ages and cultures (Blair & Razza, 2007; Bull & Scerif, 2001; Howse et al., 2003; McClelland et al., 2007; Wanless et al., 2011). The higher academic demands rooted in the complexities of math likely require greater self-regulation. Proficiency in math requires a child to actively reason through a problem to arrive at the solution and goes beyond memorization of arithmetic knowledge (Blair & Razza, 2007). The argument in the literature is that active reasoning requires self-regulation which invokes skills in the areas of attention, working memory, and inhibitory control (Epsy et al., 2004; Bull & Scerif, 2001; Blair & Razza, 2007). Self-regulation skills are thought not only to help a child attend to an end goal, but also to help retain the pertinent information and inhibit irrelevant information such as a previously applied strategy that worked on a different type of problem (Espy et al., 2004). As a result, self-regulation skills collectively and uniquely are considered to contribute to greater success in mathematic problem solving (Bull & Scerif, 2001; Blair & Razza, 2007).

1.2.3 Self-regulation and Reading

Research suggests that self-regulation may play a significant role during the development of literacy skills in preschool children (McClelland et al., 2007). McClelland et al. (2007) reported that self-regulation positively correlated to letter name and word identification. In contrast, researchers have failed to identify any significant relation between self-regulation and literacy skills in kindergarten children (Blair & Razza, 2007; Ponitz et al., 2009). Unlike the process of learning math, which likely requires greater self-regulation to master the tiered developmental process of conceptualizing, understanding procedures, and using active reasoning, a child's reading skills unfold through the use of more automated skills such as letter identification, word identification, and phonological awareness. Once a child masters these basic skills and begins to read, the skills become second nature. A skill that is performed automatically and naturally requires less planning, programming, inhibition, and overall self-regulation. As children progress through kindergarten, skills such as phonological awareness and letter-sound correspondence are mastered. This may help to explain why Ponitz et al. (2009) found that self-regulation did not significantly contribute to letter-word identification in kindergarten children. Likewise, Blair and Razza (2007) did not identify self-regulation as a significant contributor to letter identification and phonological awareness in kindergarten children. Thus, self-regulation may be more critical initially during preschool, at a time when children are acquiring early literacy-related skills, and may be less critical later when those skills become automatic.

1.2.4 Self-regulation and Writing

Skilled writing in older children likely requires higher levels of self-regulation such as planning, organization, and attentional control. Part of writing difficulties for older children may be traceable to poor acquisition or use of self-regulation processes. Compared to skilled writers, developing writers show little high-level planning and organization prior to writing (Graham & Harris, 2000; Graham, 1997; Zimmerman & Riesemberg, 1997). Graham, Harris, and Mason (2005) examined the effects of a training program to develop self-regulation strategies in at-risk writers in third grade. After receiving instruction on self-regulation strategies and prompts to use these new techniques during writing, children composed longer, more complete, and qualitatively better written work when compared to the control group.

The majority of past research on writing and self-regulation has focused on older children and children with learning disabilities or those at risk for poor writing skills. Minimal research has been completed on the role of self-regulation in early writing. An exception was a recent study by Gerde et al. (2012) that examined the contribution of several variables including self-regulation to name writing in preschool children. Self-regulation accounted for 7.1% of the total variance in children's name-writing skills after accounting for other important predictors such as letter knowledge, home literacy environment, and decoding. This recent finding suggests there is reason to pursue further research on the relation between self-regulation and early writing. If self-regulation is related to better early writing skills, then interventions such as the Self-Regulation Strategy Development (Graham et al., 2005) may help to lay the foundation for future efforts to improve young children's self-regulation skills in relation to writing.

1.2.5 Grade-specificity and Task-dependency

As indicated earlier, there is evidence to suggest that the relation between self-regulation and academic skills may be domain-specific and task-dependent. This study aims to examine further these issues of self-regulation in relation to the domain of writing. As evidenced in the math and reading research, the effects of self-regulation may vary by academic subject as children transition from preschool to kindergarten (McClelland et al., 2007, Ponitz et al., 2009). The results of this previous research suggest domain specificity of self-regulation skills. Due to limited research on the relation of self-regulation and writing in preschool and kindergarten, the current study addressed only the domain of writing with a focus on grade-specificity.

One example of an early writing task is letter-writing. Self-regulation may help preschool children to learn these skills, which are new to them. Preschool children eventually learn to write all letters of the alphabet and by kindergarten, letter-writing becomes a fairly automatic task. Hence, the effect of self-regulation for a skill such as letter-writing may decrease with time and vary by grade. In contrast, a task such as composition is more cognitively demanding for kindergarten children and may require more self-regulation. As academic tasks become more complex, cognitive demands for specific skills increase. Thus, increased self-regulation may be required as children transition from preschool to kindergarten. Due to changes in cognitive demands, the present study examined the relation of self-regulation and task-dependency by introducing more advanced writing measures for the kindergarten children.

The current study explored task-dependency to expand on the current literature base and to gain a better understanding of self-regulation. Gerde et al. (2012) examined the relation between self-regulation and the name writing task in preschool children and reported that self-regulation made a unique contribution to task performance. There is, however, contention in the

literature about what name writing truly reflects. Some argue that name writing does not reflect children's conceptual knowledge about emergent writing because the name is memorized as a whole unit (Puranik & Lonigan, 2012; Drouin & Harmon, 2009; Treiman & Broderick, 1998). To evaluate the relation between self-regulation and emergent writing more fully, letter writing and spelling tasks were included in this study to capture children's conceptual knowledge about writing. To address task-dependency both basic and advanced measures of letter writing and spelling were included for kindergarten children. As mentioned previously, when children transition from preschool to kindergarten the cognitive demands for skills change. One would expect children to have near mastery of letter writing by kindergarten. However, kindergarten children are required not only to write the letters of the alphabet, but also are expected to write them fluently and under timed conditions. Whereas letter writing may be more automatic for kindergarten children than for preschool children, a timed task such as letter writing fluency may be less automatic, and hence more difficult. Along the same lines, differences in the types of words that children are required to spell may require more or less self-regulation. Therefore, two spelling assessments that varied in task requirements and scoring complexity were used to examine task-dependency for the kindergarten children. The first task required the children to spell simple words. Scoring was based on a developmental scoring system to account for the children's developing knowledge of spelling rules. The second task used a standardized measure that was scored dichotomously. This scoring method did not consider children's developing knowledge of spelling rules. Lastly, this study included a task to assess knowledge of writing and a composition task to examine the relation of self-regulation to the highest forms of early writing in kindergarten. Due to task complexity, preschool children were not assessed on composition.

1.2.6 Aims

The aim of the current study was to explore the relation between self-regulation and emergent/early writing for preschool and kindergarten children. Specific research questions include: (1) Is there a different relation between self-regulation and children's writing skills in preschool and kindergarten?; and (2) Is the relation between self-regulation and writing task-dependent?

When examining the basic tasks (name writing, letter writing, and spelling) for preschool and kindergarten children, the relation between self-regulation and writing for both cohorts in this study was expected to mimic the relation between self-regulation and emergent reading. Research indicates that self-regulation is significantly related to reading tasks in preschool but not in kindergarten (McClelland et al., 2007; Ponitz et al., 2009). Hence, self-regulation should only contribute significantly to the name writing task for preschool children who are learning to write their names, because the task is novel. However, kindergarten children are expected to demonstrate near mastery of this task, therefore, no significant relation was anticipated between name writing and self-regulation for kindergarten children. In this study it was hypothesized that self-regulation would have a significant relation to the basic writing tasks of name writing, letter writing, and invented spelling in preschool, but not kindergarten.

Whereas some writing skills such as name writing and letter writing may require learning a finite set of letters and become automatic in time, other writing tasks such as composition could continue to be difficult for young emergent writers. For such tasks, writing may present with a similar complexity to math. Both math and writing expand on a finite set of skills. Therefore, to examine whether the relationship between self-regulation and writing was task-dependent, kindergarten children were assessed on the same constructs that were assessed in

preschool, such as letter writing and spelling, but at a more developmentally-appropriate level. For example, the letter writing task was administered as a timed measure to assess letter-writing fluency. Similarly, instead of examining invented spelling, kindergarten children were administered a standardized measure of spelling (Woodcock Johnson-III (WJ-III): Spell subtest), as well as in knowledge of writing concepts task and composition task. Table 1 provides a comprehensive outline of the study hypotheses.

Table 1. Hypotheses About the Relation Between Self-regulation and Writing Skills for Preschool and Kindergarten Children.

Preschool		
Writing Measures	Assessment	Hypothesis
Name Writing	Name Writing Task	Significant relation expected
Letter Writing	Letter Writing Task	Significant relation expected
Spelling	Invented Spelling Task	Significant relation expected
Kindergarten		
Writing Measures	Assessment	Hypothesis
Name Writing	Name Writing Task	No significant relation expected
Letter Writing	Letter Writing Task	No significant relation expected
	Letter Writing Fluency	Significant relation expected
Spelling	Invented Spelling Task	No significant relation expected
	Standardized Spelling Task (WJ-III: Spell)	Significant relation expected
Composition	Knowledge of Writing (TEWL-2: Basic)	Significant relation expected
	Composition (TEWL-2: Contextual)	Significant relation expected

Note. WJ-III = Woodcock Johnson Test of Cognitive Abilities, 3rd edition; TEWL-2= Test of Early Written Language, 2nd edition.

2.0 METHOD

2.1 PROCEDURES

In spring 2010, children were recruited from a wide range of preschools, daycare centers, and kindergartens in Pittsburgh, PA and Tallahassee, FL for an expansive four-year longitudinal study to examine emergent literacy skills. Measures of emergent literacy, oral language, self-regulation, and working memory were all collected as part of the longitudinal study, but only pertinent data are reported because of the current study's focus on early writing and self-regulation.

Each child's participation in the study was confirmed through a consent form distributed to the parent by way of the child's classroom teacher. Across both test sites, signed consents were received for 300 children. Trained assessors individually tested each child's skills over two to three visits. The length of each visit was contingent upon the child's ability to attend to the task with the average visit lasting thirty minutes.

2.2 PARTICIPANTS

The mean age of the participants enrolled in the current study was 64.7 months (*SD 9.2*; range 48-81 months). The sample test population is nearly equally split between sexes with 47.7% boys

and 52.3% girls. Preschool children (n=161) comprise 53.7% of the sample. A wide range of preschools, daycare centers and kindergartens was sampled to insure inclusion of families with diverse socioeconomic statuses (SES). English is the primary language for all study participants, as determined by a parent survey. A variety of ethnicities are represented, and none of the participants have any known developmental delays as determined by their teachers' reports. Demographic information for the participants is provided in Table 2.

Table 2. Participant Demographics

	n	Percentage of total sample
Sex		
Male	143	47.70
Female	157	52.30
Race/Ethnicity		
African American	73	24.30
Asian	8	2.70
Hispanic	8	2.50
Caucasian	197	65.70
Other	14	4.70
Chronological Age		
4 years old	103	34.30
5 years old	93	31.00
6 years old	104	34.70
Grade		
Preschool	161	53.70
Kindergarten	139	46.30
School SES		
Low	43	14.30
Low-Mid	66	22.00
Mid	61	20.30
Mid-High	109	36.30
High	17	5.70

Note. Total Sample, n=300

2.3 MEASURES

2.3.1 Self-Regulation

The Head-Toes-Knees-Shoulders task (HTKS; Ponitz et al., 2009) was used to assess self-regulation. Comparable to classroom demands, children are required to use inhibitory control and to respond using gross motor skills (Ponitz et al. 2009; Ponitz et al., 2008). The task includes four commands: “Touch your head,” “Touch your toes,” “Touch your knees,” and “Touch your shoulders.” Children must halt instinctive reactions to follow the stated command. They must demonstrate inhibitory control and instead perform the opposite of the stated task. “Touch you head” pairs with “Touch your toes”, just as “Touch your knees” pairs with “Touch your shoulders.” Accordingly, when the examiner states the command “*Touch your toes*,” the correct reaction is for the child to touch his head. The first part of the task is restricted to “Touch your head” and “Touch your toes.” In the second segment the child is trained on “Touch your knees” and “Touch your shoulders.” The training is followed with 10 test items that randomly present all four commands in a pre-determined order. Two points are assigned for each correct response. One point is assigned for a self-correction. Self-correction is defined by any noticeable movement toward a wrong answer, followed by the correct answer. Zero points are allocated for an incorrect response. A perfect score of 40 is achieved through 20 correct responses. A higher score is indicative of a higher level of self-regulation. Excellent inter-rater reliability and test-rest reliability were established for this measure (Connor et al., 2010; McClelland & Cameron, 2012). Construct validity for the HTKS was evaluated by examining correlations with the Child Behavior Rating Scale (CBRS; Bronson, Tivnan, & Seppanen, 1995). The correlation between

the HTKS and the CBRS is .25 for attentional focusing, and .20 for inhibitory control (Ponitz et al., 2009).

2.3.2 Writing Measures

Table 3 below provides an overview of the various tasks and measures used for preschool and kindergarten children. Appendix A provides details for scoring of the writing tasks.

Table 3. Writing Measures by Grade

Preschool		Kindergarten	
Writing Measure	Assessment	Writing Measure	Assessment
Name Writing	Name Writing Task	Name Writing	Name Writing Task
Letter Writing	Letter Writing Task	Letter Writing	Letter Writing Task Letter Writing Fluency
Spelling	Invented Spelling Task	Spelling	Invented Spelling Task Standardized Spelling Task (WJ-III: Spell)
		Composition	Knowledge of writing (TEWL-2: Basic) Composition (TEWL-2: Contextual)

Note. WJ-III = Woodcock Johnson Test of Cognitive Abilities, 3rd edition; TEWL-2= Test of Early Written Language, 2nd edition.

2.3.2.1 Name Writing Task Children were asked to write their first name. Name writing was scored on a developmental scale of zero to nine. Scores were assigned based on the presence or absence of developmental features of writing including linearity, directionality, phonetic representation, first letter of name, many letters of name, and correct spelling of name. The final score was the sum of all the features. Internal consistency reliability for name writing was .87 for preschool children and .86 for kindergarten children.

2.3.2.2 Letter Writing Task As a measurement of letter writing skills each child was asked to independently write 26 upper case letters dictated by the examiner in a random order. The task was verbally presented by stating, "*I want you to write out some letters for me. If you do not know them all, that is alright. Just try your best."* Responses were scored on a scale of zero to two. A score of "2" was assigned if the written letter was both correct and well formed. A score of "1" was allotted for letters that were poorly formed and/or written in reverse. An incorrect response or no response received a score of "0."

2.3.2.3 Letter Writing Fluency (LWF) A letter writing fluency task was used to assess the child's ability to write as many lowercase letters of the alphabet as possible within a one-minute time frame. Prior to the task, the child was instructed not to erase a mistake if one was made; instead the child was told to cross out the mistake and continue writing. Each letter was rated on a scale from zero to one. One point was assigned if the written letter was correct and well formed. A half-point was allotted for letters that were poorly formed and/or written in reverse. If the child wrote an incorrect letter or wrote nothing at all, a score of zero was designated.

2.3.2.4 Invented Spelling Task A researcher-generated spelling task was used to assess each child's early spelling skills. The assessment included eight consonant-vowel-consonant words. The child was prompted for the individual letters for the first three items. The examiner asked the child to write the first letter, the last letter and finally the middle letter. Responses were scored on a developmental scale with scores of zero to nine. The scale represents the progression of spelling from random letters, initial consonants, phonetically related attempts, and invented spelling to conventional spelling. Internal consistency reliability for the spelling task was high (Cronbach's α =.98) for both preschool and kindergarten children.

2.3.2.5 Standardized Spelling Task The spelling subtest was used from the Woodcock Johnson-III (WJ-III; Woodcock, McGrew, & Mather, 2001) as a more advanced measure of spelling ability. This subtest requires children to write letters and words of increasing complexity. The subtest is discontinued after the child provides six incorrect responses. Raw scores were used in the analysis for this study. The WJ-III spelling subtest has a test-retest reliability of .95 (Woodcock, et al., 2001).

2.3.2.6 Writing Concepts/Composition Task The Test of Early Written Language, 2nd Edition (TEWL-2; Hresko, Herron, Peak, 1996) is designed to assess and identify a child's strengths and weaknesses in writing. TEWL-2 contains two subtests. The basic subtest assesses a child's knowledge of writing concepts related to print awareness, spelling, and sentence combining. The subtest is terminated once the child provides five incorrect responses. The contextual writing subtest of the TEWL-2 assesses the child's ability to write a story based upon a picture prompt. Only children who were age five and above completed this measure. The picture prompt is comprised of three sequential action pictures. The child is instructed to write a story about the

pictures. Although most children do not exceed five minutes of writing, each child is provided fifteen minutes to complete the task. Raw scores were used in the analysis for this study. Internal consistency reliability is α =.94 (TEWL-2, Hresko et al., 1996). Concurrent validity was established with a variety of assessments. The TEWL-2 is moderately correlated to the Peabody Individual Achievement Test-Revised (PIAT-R; Markwardt, 1989) Written language (Basic = .65; Contextual = .57), the Wide Range Achievement Test (WRAT-R; Jastak & Wilkinson, 1984) Spelling (Basic = .47; Contextual = .47) and the Diagnostic Achievement Battery (DAB; Newcomer, 1990) Writing (Basic = .56; Contextual = .49).

2.3.3 Reliability of Scoring

Two trained researchers scored all tasks to establish inter-rater reliability and to reduce data entry errors. Samples were coded based on previously established coding guidelines. All discrepancies were discussed and resolved. Both raters agreed on the final scores entered. The percentages for correct agreement were calculated for the non-standardized assessments and were as follows: 92.0%, 93.2%, and 97.8% for letter writing, the spelling task, and name writing, respectively.

3.0 RESULTS

Across all study measures the preschool group had all data present, whereas the kindergarten group had three participants with missing data. The study participants were nested within 120 schools. The current study used multi-level modeling to account for school influence as a contributor to differences in writing scores. These multi-level analyses were conducted using Mplus (Muthén & Muthén, 2010).

To examine the influence of child and school level factors, intraclass correlation coefficients (ICCs) were calculated for each writing measure for the preschool and kindergarten groups. Large ICC values for both age groups indicate that a substantial amount of variance was explained at the school level and suggests that children from the same schools had scores that are highly related to each other. The ICCs at the school level for individual writing scores of the preschool group were as follows: 13.41, 13.61 and 35.35 for name writing, letter writing, and spelling, respectively. The kindergarten group completed the above named measures in addition to four other higher-level writing measures. Variances for the kindergarten ICCs at the school level for each of the writing measures which overlapped with the preschool writing measures were as follows: 13.64, 18.45 and 12.30 for name writing, letter writing, and spelling, respectively. Intraclass correlations at the school-level were also calculated for additional kindergarten writing measures of letter writing fluency, WJ-III spelling subtest, and the TEWL-2 Basic and Contextual assessments. The respective ICCs were 18.95, 27.58, 26.50 and 18.95.

Based on the standards recommended by Kline (2005) for skewness and kurtosis, the only measure with a problematic distribution was kindergarten name writing. However, variability within measures did exist. Therefore, Bayesian estimation was used in each model to address non-normality of the data.

3.1 DESCRIPTIVE STATISTICS

Descriptive statistics were examined separately by grade and are summarized in Table 4. The mean preschool HTKS score was 16.48 (*SD* = 13.75). Large variability was noted in the preschool self-regulation scores as measured by HTKS. Twenty-one percent of the sample obtained a score of zero, or showed floor effects, and 1.2% of the sample attained a perfect score, or showed ceiling effects. Within the preschool group, girls scored an average of six points higher than boys on the HTKS measure. Next, the data were examined for the preschool writing measures (see Table 4). Means and standard deviations for the writing measures were 7.55 (*SD* = 2.14), 20.63 (*SD* = 16.77), and 32.33 (*SD* = 18.34) for name writing, letter writing and spelling, respectively. For the name writing task, almost 53% scored at ceiling. Both letter writing and spelling had large standard deviations indicating large variability in student performance. Lastly, correlations between measures were examined for the preschool group. HTKS score was significantly correlated with all preschool writing measures. Similarly, all preschool writing variables were significantly correlated with each other (see Table 5).

The means and standard deviations for the kindergarten measures were examined next, followed by an examination of correlations. The mean HTKS score was 33.24 (*SD* = 8.20). As expected, less variability was noted in the HTKS scores for the kindergarten group as compared

to the preschool group. Approximately 94% of the kindergarten children scored over 20 points. Only 0.7% scored at floor, and 5.8% scored at ceiling. Turning to the writing variables, name writing had a mean of 33.24 (*SD* = 8.20). As anticipated, 95.7% of the kindergarten sample obtained a score of nine; the highest score possible on the name writing task. Similarly, their letter writing scores averaged close to ceiling, with a mean of 45.29 (*SD* = 4.77). The added time restraint that accompanied the letter writing fluency task dropped the mean to 12.89 (*SD* = 6.70). Similarly to the letter writing task, the basic spelling task showed a high average of 65.92 (*SD* = 4.95). Approximately 90% of the sample scored above 60 points. Raw scores were used for all of the standardized assessments. The means (and *SD*s) for WJ-III: Spell, TEWL-2: Basic and TEWL-2: Contextual subtests were 17.51 (3.02), 33.26 (0.34), and 6.94 (5.31), respectively. As reported in Table 6, HTKS performance for kindergarten children was significantly correlated to spelling (r = .25; $p < .001$), TEWL-2: Basic (r = .24; $p < .001$) and TEWL-2: Contextual subtest performance (r = .18; $p < .005$). All kindergarten writing measures were significantly correlated with each other with the exception of name writing, which was only significantly correlated with spelling (r = .28; $p < .001$). Both the unstandardized and standardized spelling measures revealed the highest correlations with the other writing measures.

Table 4. Descriptive Statistics for Preschool (n= 161) and Kindergarten (n=139) Samples

	Preschool					Kindergarten				
Variable	Mean	SD	Range	Skewness	Kurtosis	Mean	SD	Range	Skewness	Kurtosis
Child age (Months)	57.37	5.53	48-72	0.35	-0.60	73.21	3.69	61-81	-0.71	1.03
Self-Regulation										
HTKS	16.48	13.75	0-40	0.17	-1.46	33.24	8.20	0-40	-2.61	7.01
Writing measures										
Name Writing	7.55	2.14	0-9	-1.72	2.56	8.95	0.25	7-9	-5.47	32.62
Letter Writing	20.63	16.77	0-52	0.34	-1.32	45.29	4.77	33-52	-0.63	-0.30
Letter Writing Fluency						12.89	6.70	1-26	0.30	-0.97
Invented Spelling	32.33	18.34	0-70	0.38	-0.96	65.92	4.95	45-71	-2.01	4.42
WJ-III: Spell						17.51	3.02	11-26	0.62	0.33
TEWL-2: Basic						33.26	6.31	17-48	-0.37	0.03
TEWL-2: Contextual						6.94	5.31	0-26	1.17	1.53

Note. HTKS= Head-Toes-Knees-Shoulders; WJ-III= Woodcock Johnson Test of Cognitive Abilities, 3rd edition; TEWL-2= Test of Early Written Language, 2nd edition. All reported data are raw scores. Letter Writing Fluency, n=136.

Table 5. Pearson Correlations: Preschool Sample

	1	2	3	4	5
1. HTKS	——–				
2. Sex	-.24**	——–			
3. Name Writing	.31**	-.21**	——–		
4. Letter Writing	.43**	-.09	.56**	——–	
5. Invented Spelling	.46**	-.10	.51**	.82*	——–

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Note. n= 161 for preschool group; HTKS = Head-Toes-Knees-Shoulders

Table 6. Pearson Correlations: Kindergarten Sample

	1	2	3	4	5	6	7	8	9
1. HTKS	—								
2. Sex	-.07	—							
3. Name Writing	-.01	-.03	—						
4. Letter Writing	.10	-.27**	.09	—					
5. Letter Writing Fluency	.14	-.19*	.15	.29**	—				
6. Invented Spelling	.25**	-.11	.28**	.31**	.42**	—			
7. WJ-III: Spell	.12	-.18*	.06	.46**	.49**	.55**	—		
8. TEWL-2: Basic	.27**	-.12	-.02	.40	.45**	.54**	.67**	—	
9. TEWL-2: Contextual	.18*	-.19*	.15	.18*	.25**	.41**	.31**	.56**	—

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Note. n= 139 for kindergarten group; n= 136 for Letter Writing Fluency; HTKS= Head-Toes-Knees-Shoulders

3.2 MULTI-LEVEL MODELING RESULTS

Multi-level modeling (MLM) results are reported separately for preschool and kindergarten (see Appendix B for the MLM equation). The MLM models included chronological age and sex as control variables. Sex was dummy coded (1= girls; 2= boys). Separate models were calculated for each of the outcome variables for preschool and kindergarten. Model 1 consisted of the control variables. Model 2 additionally included HTKS scores to examine the unique variance of self-regulation as a contributor to various writing tasks.

Self-regulation for the preschool group was significantly related to letter writing and spelling, but not to the name writing scores ($p < 0.008$; $p < 0.008$; p = .20, respectively). In Model 1, chronological age and sex accounted for 24.70% and 23.20% of the variance for letter writing and spelling respectively (see Table 7). The addition of HTKS scores in Model 2 contributed 2.5% of unique variance to letter writing and 2.1% of unique variance to spelling. For the kindergarten group self-regulation scores were not significantly related to name writing, letter writing, letter writing fluency, spelling, or WJ-III: Spell. Self-regulation was only significantly related to the TEWL-2: Basic Writing and TEWL-2: Contextual Writing scores ($p < 0.03$; $p < .01$, respectively; see Table 8). In Model 1, the control variables explained 5% of the variance for the TEWL-2: Basic Writing subtest and 7.60% of the variance for the TEWL-2: Composition Writing subtest. The HTKS scores added to Model 2 uniquely contributed 4% to the explained variance for the TEWL-2 Basic subtest. Although self-regulation was significantly related to the compositional measure, it did not add any unique variance for the TEWL-2: Composition Writing subtest.

Table 7. Preschool Multi-Level Modeling Results

Name Writing				
	Model 1		Model 2	
Variables	Coefficient (SE)	*P*	Coefficient (SE)	*p*
Chronological Age	.31 (.07)	0.00	.30 (.08)	0.00
Sex	−.20 (.08)	0.00	−.11 (.07)	0.06
HTKS			.05 (.08)	0.40
Letter Writing				
	Model 1		Model 2	
Variables	Coefficient (SE)	*P*	Coefficient (SE)	*p*
Chronological Age	.49 (.06)	0.00	.44 (.07)	0.00
Sex	−.12 (.07)	0.11	.00 (.07)	0.94
HTKS			.20 (.07)	0.01
Invented Spelling				
	Model 1		Model 2	
Variables	Coefficient (SE)	*P*	Coefficient (SE)	*p*
Chronological Age	.47 (.08)	0.00	.42 (.08)	0.00
Sex	−.14 (.06)	0.03	.05 (.07)	0.53
HTKS			.19 (.07)	0.01

Note. HTKS= Head-Toes-Knees-Shoulders.

Table 8. Kindergarten Multi-Level Modeling Results

Name Writing				
	Model 1		Model 2	
Variables	Coefficient (SE)	*P*	Coefficient (SE)	*p*
Chronological Age	−.16 (.10)	0.12	.17 (.09)	0.05
Sex	−.04 (.04)	0.34	.05 (.11)	0.75
HTKS			−0.02 (.08)	0.82
Letter Writing				
	Model 1		Model 2	
Variables	Coefficient (SE)	*P*	Coefficient (SE)	*p*
Chronological Age	.01 (.09)	0.92	.01 (.09)	0.94
Sex	−0.24 (.04)	0.00	−0.21 (.11)	0.09
HTKS			.05 (.08)	0.49

Table 8 (continued)

Letter Writing Fluency				
	Model 1		Model 2	
Variables	Coefficient (SE)	*P*	Coefficient (SE)	*p*
Chronological Age	.16 (.10)	0.11	.15 (.09)	0.08
Sex	−0.19 (.08)	0.00	−0.19 (.07)	0.00
HTKS			.07 (.08)	0.46
Invented Spelling				
	Model 1		Model 2	
Variables	Coefficient (SE)	*P*	Coefficient (SE)	*p*
Chronological Age	.24 (.08)	0.00	.24 (.08)	0.01
Sex	−0.23 (.04)	0.00	−0.04 (.11)	0.74
HTKS			.11 (.08)	0.14
WJ-III: Spell				
	Model 1		Model 2	
Variables	Coefficient (SE)	*P*	Coefficient (SE)	*P\p*
Chronological Age	.18 (.10)	0.04	.18 (.09)	0.08
Sex	−0.16 (.04)	0.00	−0.12 (.11)	0.44
HTKS			.08 (.08)	0.30
TEWL-2: Basic				
	Model 1		Model 2	
Variables	Coefficient (SE)	*P*	Coefficient (SE)	*p*
Chronological Age	.18 (.10)	0.06	.18 (.09)	0.08
Sex	−0.14 (.04)	0.00	−0.06 (.11)	0.71
HTKS			.19 (.08)	0.03
TEWL-2: Contextual				
	Model 1		Model 2	
Variables	Coefficient (SE)	*P*	Coefficient (SE)	*p*
Chronological Age	.05 (.09)	0.61	.06 (.09)	0.53
Sex	−0.27 (.06)	0.00	−0.1 (0.1)	0.55
HTKS			.21 (.08)	0.01

Note. HTKS= Head-Toes-Knees-Shoulders; WJ-III= Woodcock Johnson Test of Cognitive Abilities, 3rd edition; TEWL-2= Test of Early Written Language, 2nd edition.

To interpret the pattern of these findings, grade-specific relations were examined between self-regulation and three aspects of the early writing assessments for preschool and kindergarten:

name writing, letter writing, and spelling (see Table 9). In the current study, self-regulation did not relate to the name writing task for preschool or kindergarten children. For the letter writing and spelling tasks, however, the pattern differed; self-regulation significantly contributed to letter writing and invented spelling in the preschool sample but was not significantly related to these writing measures in the kindergarten children. In other words, self-regulation had grade-specific relations to letter writing and spelling.

Furthermore, self-regulation did not make a statistically significant contribution to spelling and letter writing fluency for kindergarten children. For composition, however, self-regulation had a significant and positive relation to both tasks. This pattern of results suggests that self-regulation is not task dependent, but does vary for different aspects of writing.

4.0 DISCUSSION

There were two aims for the present study: (1) to examine the relation between self-regulation and children's writing skills in preschool and kindergarten; and (2) to determine if the relation between behavioral self-regulation and writing is task-dependent. Findings suggest that although self-regulation is related to many aspects of early writing, there are grade-level differences in the aspects of early writing to which it relates. Specifically, self-regulation positively and significantly relates to letter writing and spelling in preschool, but not in kindergarten. Although this study did not assess composition in preschool, the relation between self-regulation and composition was significant in kindergarten. These differences may suggest that self-regulation is most related to skills that align with the child's developmental level.

Results suggest that self-regulation is importantly related to aspects of emergent and early writing in preschool, with the exception of name writing. For the preschool sample in the current study, MLM results did not show a significant relation between self-regulation and the name-writing task. These results contradict previous research by Gerde et al. (2012), who found self-regulation to be a significant contributor to name writing for preschool children. The difference in the studies' findings may be due to a slight variance in the participants' ages and the time during the school year when the tests were administered. The children in the current study were on average 10 months older than those in the previous study, and had seven additional months of formal education prior to testing. As a result, the majority of preschool children in the current

study scored between seven and nine points on the name writing task, and typically achieved ceiling performance. These results suggest mastery of name writing. Although the present study result contradicts the Gerde el al. (2012) finding of a significant relation between name writing and self-regulation, the present study's findings are consistent with the hypothesis that mastered skills require or engage less self-regulation than novel skills. Also consistent with this study's hypothesis, the results of the present study indicate that self-regulation significantly and positively relates to the preschool writing tasks of letter writing and spelling. Both are novel skills in preschool. MLM results further showed that self-regulation uniquely accounted for slightly over 2% of the variance for both letter writing and spelling. These findings are consistent with past research which identified self-regulation's role in the early academic skills of math and literacy in preschool children (Epsy et al., 2004, McClelland et al., 2007) because they suggest that self-regulation skills may also be important for preschool children's emergent writing skills.

The kindergarten sample showed a different pattern of results. As expected, the raw scores for kindergarten indicated near-mastery of the name writing, letter writing and invented spelling tasks. Thus, performance on these tasks did not covary with individual differences in self-regulation. A ceiling effect in the name writing, letter writing and invented spelling tasks was expected in kindergarten because these tasks assessed a basic finite set of skills that are typically mastered early (Ritchey, 2008; Bloodgood, 1999; Puranik & Al Otaiba, 2012). These results in combination with the preschool results suggest that the relation of self-regulation and writing is grade-specific.

This grade-specific relation was further examined by considering task-dependency. The advanced measures of letter writing fluency and spelling (WJ-III: Spell subtest) were introduced in the current study to assess kindergarten children in a manner that aligned with their

developmental stage. Self-regulation was expected to have a similar role in writing as it does in math. That is, the relevance of self-regulation was expected to remain constant as the tasks grew in complexity between preschool and kindergarten (Bull & Scerif, 2001; Blair & Razza, 2007). MLM results indicated, however, that self-regulation did not significantly relate to the advanced measures of the letter writing fluency task or the WJ-III: Spell subtest. These results suggest that the covariation between self-regulation and writing performance is not task dependent. Regardless of the task used to assess the constructs of letter writing and spelling, self-regulation did not significantly relate to these constructs in kindergarten.

One explanation for the discrepancy between this study's hypothesis and the results may relate to the design of the individual tasks. For example, the letter writing fluency task required a very automatic script—the alphabet. The structure and familiarity of this task possibly decreased the relevance of self-regulation. Further, this task was designed as a classroom assessment. However, the children in this study were evaluated in a one-on-one environment. In a classroom environment, children are required to independently follow instructions so that they begin the task on time, stay on task, and use the full time allotted. The present study attempted to control typical environmental distractions. This approach may have unintentionally compensated for variance in self-regulation needs by furnishing unintended external regulation, which decreased the need for inhibitory control and helped the child to succeed at the task. Much like the letter writing fluency task, a close examination of the standardized spelling test in kindergarten indicated that the self-regulation behavior may be less relevant to this task than anticipated. During the testing children were asked to write sight words and words that use learned endings and grammatical rules such as –ed and the silent e. The mean task score was 17.51 (SD = 3.02), however, the task's first 14 points were earned using tracing and letter writing skills which are

typically mastered early in kindergarten (Ritchey, 2008). Thus, this task did not increase the demand for knowledge of phoneme-sound correspondence, but instead assessed children's crystalized intelligence related to spelling rules. It has been suggested that self-regulation overlaps with fluid intelligence more than crystalized intelligence (Blair, 2006). Thus, the nature of the task may not have required self-regulation to succeed.

Self-regulation did not significantly relate to letter writing fluency or an advanced measure of spelling for kindergarten children. Successful writing, however, requires children to integrate these early letter writing and spelling skills into written language. Kindergarten children in the current study were challenged further with tasks that assessed their understanding of written language and additionally required them to use emergent/early writing skills, such as letter writing and spelling within a single task. Self-regulation was found to relate significantly to the understanding of written language (TEWL-2: Basic) in kindergarten. These results are consistent with this study's expectations. MLM results indicated that self-regulation accounted for 4% of the unique variance on TEWL-2: Basic writing tasks. This suggests that the early forms of self-regulation may play a role in the foundation of compositional writing. The kindergarten children in this study also completed a composition task that required independent generation of writing, the TEWL-2: Contextual Writing subtest. The task invoked skills in the areas of attention, working memory and inhibitory control, all of which are incorporated in the construct of self-regulation. As expected, self-regulation related significantly to the composition task. These results are consistent with past research that suggests that the discourse level of written language requires more advanced self-regulatory skills to organize, plan, and revise (Graham & Harris, 2000; Berninger & Amtmann, 2003). Although self-regulation in the present

study related significantly to the composition task, it did not account for any unique variance beyond the variance that was accounted for by the control variables of sex and age.

4.1 LIMITATIONS

In the presence of limitations, the current study revealed important links between early/emergent writing skills and self-regulation. First, the current study cannot make any causal claims that improving self-regulation will improve early writing scores or will predict future writing scores. Other factors such as a child's socioeconomic status, family characteristics, motivation or cognition may be playing an underlying role. Additional research is needed to draw such conclusions. Second, the discrepancy between this study's hypothesis and the results, which did not substantiate task-dependency, suggests the need for inclusion of a wider range of more finely-tuned assessments. The tasks used to assess the more advanced levels of writing may not have accurately captured the effects of self-regulation on writing at this developmental age. Finally, the one-on-one environment, or manner in which the assessments were completed, likely impacted the study's findings. As discussed, this study controlled for environmental distractions. Such control may indirectly increase external regulation. A structured environment like this may help children complete tasks more successfully, with less reliance on self-regulation skills. Although a one-on-one environment is ideal to elicit a child's best performance on the task, normal circumstances dictate that children employ these skills in a classroom setting. Thus, the true amount of self-regulation related to these early writing tasks in a classroom setting may be underestimated in the current study.

4.2 IMPLICATIONS AND FUTURE RESEARCH

The results of this study add to the growing literature on the role self-regulation plays in children's early academic skills, specifically early writing. Study indicators suggest that a relation exists between self-regulation and certain aspects of writing for both preschool and kindergarten children. This novel finding suggests an important future avenue for research to determine whether focusing on children's self-regulation skills during early development may strengthen their writing foundation. The current study findings in conjunction with findings from previous literature suggest that practicing these skills with children during the early preschool years may be beneficial (Diamond, Barnett, Thomas, & Munro, 2007; Brock, Rimm-Kaufman, & Wanless, 2014). Brock et al. (2014) propose that children with high self-regulation skills benefit from a different classroom structure than those with low self-regulation skills. It may also be important for teachers to use early assessments of self-regulation to help identify children with lower self-regulation skills who may be at risk for problems with some aspects of writing. With such knowledge, teachers can provide additional assistance and compensate for the lower skills with increased external regulation.

Future research should focus on the limitations of this study to further improve the understanding of the relation between self-regulation and early writing. First, other potentially important variables, related to SES, the child's family characteristics, and the like, also should be examined as potential mediators or moderators of any relation between self-regulation and writing performance. In addition, a longitudinal study to determine whether children's self-regulation skills in preschool are predictors of children's writing skills in kindergarten would add value to the current literature that pertains to early self-regulation skills and their ability to predict academic achievements in math and literacy in future grades. Future research should also

focus on assessment batteries that capture the full impact of self-regulation throughout emergent and early writing skills. Assessment batteries should include a variety of writing measures for each writing element to strengthen the results of the current study. Likewise, it would be beneficial to compare these early writing measures to both direct and indirect measures of self-regulation. A comparison that measures these skills through both one-on-one instruction and the indirect measure of teacher's ratings of self-regulation for each student in a classroom setting would provide a more comprehensive assessment of children's self-regulation skills. Future research also should consider assessing writing and self-regulation skills in a classroom setting, as it is the most natural learning environment. Using a one-on-one environment in conjunction with classroom measures would provide a more complete picture of children's true skills.

An extension of the current research will help to more definitively identify the extent and nature of relations between self-regulation and early writing. Hopefully, this information will deepen our understanding of the role of self-regulation in relation to early writing and provide additional evidence about the validity of extending current interventions for self-regulation to improve writing for preschool and kindergarten children.

APPENDIX A

SCORING OF WRITING TASKS

Table 9. Scoring of Name Writing

Feature	Description
Linearity	Marks appear organized around a horizontal or vertical axis (i.e., the forms are not distributed randomly over the page).
Segmentation/Discreteness	Writing contains distinguishable/separate units (e.g., circles, dots, letters, or letter like characters that are separated). Child needs to have at least 2 units to receive credit; marks appear relatively separated from each other with more or less regular blanks between them. A cursive line that goes up and down repeatedly is considered segmented (imitation of adult cursive writing).
Simple units	Presence of distinguishable units, e.g., dots, lines, or circles. The child must have written at least 2 units to receive credit.
Left-to-right orientation	Writes from left to right.
Complex characters	Combination of real and pseudo letters
Writes first letter of name	If only first letter is written, examine writing samples from other sections to determine the presence or absence of previous writing features.
Random Letters	Real letters only
Many letters	More than half of the letters in first name
Conventional	Correct spelling of first name

Note. Responses were scored with a 1 or 0 for the absence or presence of each feature; Inverted letters were counted as correct in this section.

Table 10. Scoring of Letter Writing

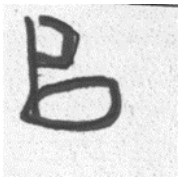
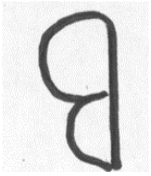
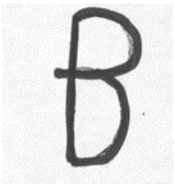
Score	Description	Example 1	Example 2
0	No response, wrong letter, unrecognizable		
1	Poorly formed/written letter, reversals		
2	Completely legible letter		

Table 11. Scoring of Spelling

Score	Stage	Rule
0		No response
1	Graphic	A scribble produced by scratching.
2		A single good form (e.g., a square, a circle-like form, a triangle-like form) not produced just by scratching, but in a more controlled manner.
3	Literate	Conventional symbol: The writing contains at least one real letter not phonetically related to the letters in the word. A dot or circle on its own is not considered a conventional symbol.
4		Random string of letters: More than one random (not phonetically related) letters.
5	Early Phonetic	Early phonetic representation: The writing contains at least a single letter that is phonetically related to the word of the child was asked to write in any position of the word.
6		Correct first letter of the word: Correct first letter in initial position and/or with other phonetically related letters.
7	Phonetic	Multiple phonetic representations: The writing contains 2/3 related phonemes but not a repetitions of the same letter. The first letter of the word must be in the initial position.
8		Invented spelling: The writing contains two or more phonetic letters that represent most of the word's phonemes, along with any attempt to represent the vowel.
9	Correct	Conventional spelling: The word the child was asked to write is written in its conventional form.

APPENDIX B

MULTI-LEVEL MODELING EQUATION

Level 1: $Y_{ij} = \beta_{0j} + \beta_{1j}\,(\text{Age}_{ij}) + \beta_{2j}\,(\text{Gender}_{ij}) + \beta_{3j}\,(\text{HTKS}_{ij}) + r_{ij}$

Level 2: $\beta_{0j} = \gamma_{00} + u_{0j}$

Level 2: $\beta_{1j} = \gamma_{10} + u_{1j}$

Level 2: $\beta_{2j} = \gamma_{20} + u_{2j}$

Level 2: $\beta_{3j} = \gamma_{30} + u_{3j}$

The outcome, the writing task measured (Y_{ij}) for child i in school j, is a function of the coefficients (β_{nj}) at Level 1 plus the part of the error that is associated with the child level. Level 2 is the outcome, the writing task measured (Y_{ij}) for child i in school j, is a function of thecoefficients (βnj) at Level 1 plus the part of the error that is associated with the classroom level.

BIBLIOGRAPHY

Berninger, V. W., & Amtmann, D. (2003). Preventing written expression disabilities through early and continuing assessment and intervention for handwriting and/or spelling problems: Research into practice.

Blair, C. (2006). How similar are fluid cognition and general intelligence? A developmental neuroscience perspective on fluid cognition as an aspect of human cognitive ability. *Behavioral and Brain Sciences*, *29*, 109-160.

Blair, C. (2002). School readiness: Integrating cognition and emotion in a neurobiological conceptualization of children's functioning at school entry. *American Psychologist*, *57*, 111.

Blair, C., & Diamond, A. (2008). Biological processes in prevention and intervention: The promotion of self-regulation as a means of preventing school failure. *Development and psychopathology*, *20*, 899-911.

Blair, C., & Razza, R. P. (2007). Relating effortful control, executive function, and false belief understanding to emerging math and literacy ability in kindergarten. *Child Development*, *78*, 647-663.

Bloodgood, J. W. (1999). What's in a name? Children's name writing and literacy acquisition. *Reading Research Quarterly*, *34*, 342-367.

Bourdin, B., & Fayol, M. (1994). Is written language production more difficult than oral language production? A working memory approach. *International Journal of Psychology*, *29*, 591-620.

Bourdin, B., Fayol, M., & Darciaux, S. (1996). The comparison of oral and written modes on adults' and children's narrative recall. In G. Rijlaarsdam, H. Van den Bergh and Couzijn, M. (Eds.), *Theories, models and methodology in writing research* (pp. 121-141). Amsterdam: Amsterdam University Press.

Brock, L. L., Rimm-Kaufman, S. E., & Wanless, S. B. (2014). Delay of gratification in first grade: The role of instructional context. *Learning and Individual Differences*, *29*, 81-88.

Bronson, M. B., Tivnan, T., & Seppanen, P. S. (1995). Relations between teacher and classroom activity variables and the classroom behaviors of prekindergarten children in Chapter 1 funded programs. *Journal of Applied Developmental Psychology, 16,* 253–282.

Bull, R., & Scerif, G. (2001). Executive functioning as a predictor of children's mathematics ability: Inhibition, switching, and working memory. *Developmental Neuropsychology, 19*, 273-293.

Connor, C. M., Ponitz, C. C., Phillips, B. M., Travis, Q. M., Glasney, S., & Morrison, F. J. (2010). First graders' literacy and self-regulation gains: The effect of individualizing student instruction. *Journal of School Psychology, 48*, 433-455.

Diamond, A., Barnett, W. S., Thomas, J., & Munro, S. (2007). Preschool program improves cognitive control. *Science, 318*, 1387.

Drouin, M., & Harmon, J. (2009). Name writing and letter knowledge in preschoolers: Incongruities in skills and the usefulness of name writing as a developmental indicator. *Early Childhood Research Quarterly*, *24*, 263-270.

Dyson, A. H. (1983). The role of oral language in early writing processes. *Research in the Teaching of English*, 1-30.

Espy, K. A., McDiarmid, M. M., Cwik, M. F., Stalets, M. M., Hamby, A., & Senn, T. E. (2004). The contribution of executive functions to emergent mathematic skills in preschool children. *Developmental Neuropsychology, 26*, 465-486.

Gerde, H., Skibbe, L., Bowles, R., & Martoccio, T. (2012). Child and home predictors of children's name writing. *Child Development Research, 2012*.

Graham, S. (1997). Executive control in the revising of students with learning and writing difficulties. *Journal of Educational Psychology*, *89*, 223-234.

Graham, S., Harris, K. R., & Mason, L. (2005). Improving the writing performance, knowledge, and self-efficacy of struggling young writers: The effects of self-regulated strategy development. *Contemporary Educational Psychology, 30,* 207-241.

Graham, S., & Harris, K. R. (2000). The role of self-regulation and transcription skills in writing and writing development. *Educational Psychologist, 35,* 3-12.

Hayes JR. A new framework for understanding cognition and affect in writing. In C.M. Levy & S. Ransdall (Eds.), *The science of writing* (pp. 1-27). Mahwah, NJ: Erlbaum.

Hresko, W., Herron, S., & Peak, P. (1996). *Test of early written language* (2nd ed.) Austin, TX: PRO-ED.

Howse, R. B., Calkins, S. D., Anastopoulos, A. D., Keane, S. P., & Shelton, T. L. (2003). Regulatory contributors to children's kindergarten achievement. *Early Education and Development, 14,* 101-119.

Jastak, S. R., & Wilkinson, G. S. (1984). *Wide Range Achievement Test: WRAT-R.* Western Psychological Services.

Kim, Y. S., Al Otaiba, S., Puranik, C., Folsom, J. S., Greulich, L., & Wagner, R. K. (2011). Componential skills of beginning writing: An exploratory study. *Learning and Individual Differences, 21,* 517-525.

Kline, R. B. (2005). *Principles and practice of structural equation modeling (2nd ed.*). New York, NY: Guilford Press.

Kopp, C. B. (1982). Antecedents of self-regulation: A developmental perspective. *Developmental Psychology, 18*(2), 199.

Lan, X., Legare, C. H., Ponitz, C. C., Li, S., & Morrison, F. J. (2011). Investigating the links between the subcomponents of executive function and academic achievement: A cross-cultural analysis of Chinese and American preschoolers. *Journal of Experimental Child Psychology, 108,* 677-692.

Levin, I., & Aram, D. (2004). Children's names contribute to early literacy: A linguistic and social perspective. In D. Rabid & H. Bat-Shyldkrot (Eds.), *Perspectives on language and language development* (pp. 219–239). Dordrecht, The Netherlands: Kluwer.

Levin, I., & Bus, A. (2003). How is emergent writing based on drawing? Analysis of children's products and their sorting by children and mothers. *Developmental Psychology, 39,* 891–905.

Markwardt, F. C. (1989). *Peabody individual achievement test-revised: PIAT-R.* Circle Pines: American Guidance Service.

McClelland, M. M., Acock, A. C., & Morrison, F. J. (2006). The impact of kindergarten learning-related skills on academic trajectories at the end of elementary school. *Early Childhood Research Quarterly, 21,* 471-490.

McClelland, M. M., & Cameron, C. E. (2012). Self-regulation in early childhood: Improving conceptual clarity and developing ecologically valid measures. *Child Development Perspectives, 6,* 136-142.

McClelland, M. M., Cameron, C. E., Connor, C. M., Farris, C. L., Jewkes, A. M., & Morrison, F. J. (2007). Links between behavioral regulation and preschoolers' literacy, vocabulary, and math skills. *Developmental Psychology, 43,* 947-959.

McClelland, M. M., Piccinin, A., & Stallings, M. C. (2010). Relations between preschool attention and sociability and later achievement outcomes. *Manuscript under review*.

Muthén, B., & Muthén, L. K. (2010). Mplus (Version 6.11). Los Angeles, CA: Author.

National Assessment of Educational Progress (2011). Writing 2011: National assessment of educational progress at grades 8 and 12. *U.S. Department of Education.*

National Commission on Writing in America's Schools and Colleges. (2003). The neglected "R": A need for a writing revolution. New York: The College Board.

Newcomer, P. (1990). Diagnostic achievement battery PRO-ED. *Austin, TX*.

Olive, T., & Kellogg, R. T. (2002). Concurrent activation of high-and low-level production processes in written composition. *Memory & Cognition*, *30*, 594-600.

Ponitz, C. C., McClelland, M. M., Jewkes, A. M., Connor, C. M., Farris, C. L., & Morrison, F. J. (2008). Touch your toes! Developing a direct measure of behavioral regulation in early childhood. *Early Childhood Research Quarterly, 23,* 141–158.

Ponitz, C. C., McClelland, M. M., Matthews, J. S., & Morrison, F. J. (2009). A structured observation of behavioral self-regulation and its contribution to kindergarten outcomes. *Developmental Psychology, 45*, 605-619.

Puranik, C., & AlOtaiba, S. (2012). Examining the contribution of handwriting and spelling to written expression in kindergarten children. *Reading and Writing, 25*, 1523-1546.

Puranik, C. S., & Lonigan, C. J. (2011). From scribbles to scrabble: Preschool children's developing knowledge of written language. *Reading and Writing, 24*, 567-589.

Puranik, C. S., & Lonigan, C. J. (2012). Name-writing proficiency, not length of name, is associated with preschool children's emergent literacy skills. *Early Childhood Research Quarterly, 27*, 284-294.

Rimm-Kaufman, S. E., & Wanless, S. B. (2012). An ecological perspective to understanding the early development of self-regulatory skills, social skills, and achievement. *Handbook of early childhood education*, 299-323.

Ritchey, K. D. (2008). The building blocks of writing: Learning to write letters and spell words. *Reading and writing*, *21*, 27-47.

Tolchinsky, L. (2003). *The cradle of culture and what children know about writing and numbers before being taught*. Mahwah, NJ: Lawrence Erlbaum Associates.

Treiman, R., & Broderick, V. (1998). What's in a name: Children's knowledge about the letters in their own names. *Journal of Experimental Child Psychology,70*, 97-116.

von Suchodoletz, A., Gestsdottir, S., Wanless, S. B., McClelland, M. M., Birgisdottir, F., Gunzenhauser, C., & Ragnarsdottir, H. (2013). Behavioral self-regulation and relations to emergent academic skills among children in Germany and Iceland. *Early Childhood Research Quarterly, 28*, 62-73.

Wanless, S. B., McClelland, M. M., Acock, A. C., Chen, F. M., & Chen, J. L. (2011). Behavioral regulation and early academic achievement in Taiwan. *Early Education & Development, 22*, 1-28.

Wanless, S. B., McClelland, M. M., Acock, A. C., Ponitz, C. C., Son, S.H., Lan, X., . . . Li, S. (2011). Measuring behavioral regulation in four societies. *Psychological Assessment, 23*, 364-378.

Woodcock, R., McGrew, K., Mather, N. (2001*). Woodcock-Johnson III tests of cognitive abilities*. Itasca, IL: Riverside.

Zimmerman, B. J., & Risemberg, R. (1997). Becoming a self-regulated writer: A social cognitive perspective. *Contemporary Educational Psychology, 22*, 73-101.